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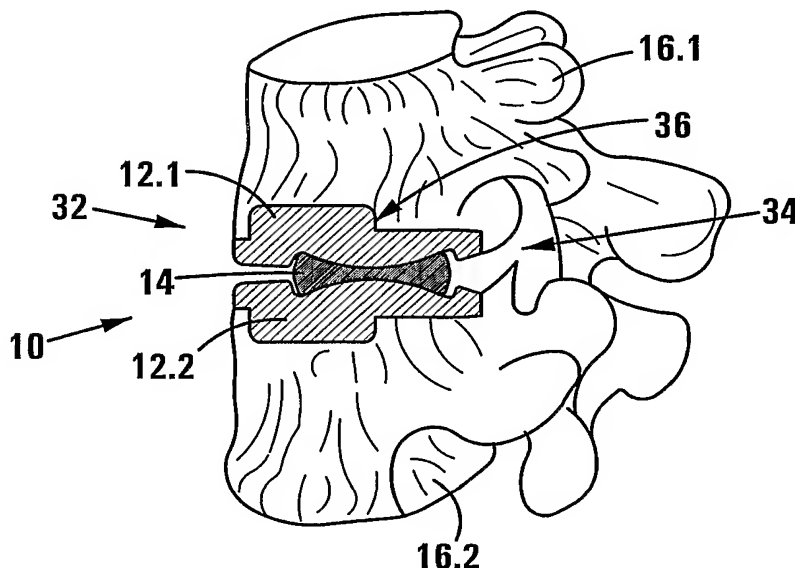
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Published:

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For two-letter codes and other abbreviations, refer to the "Guid-  
ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.

(54) Title: AN INTERVERTEBRAL PROSTHESIS



(57) Abstract: The intervertebral prosthesis (10) is used to replace a damaged natural intervertebral disc. The intervertebral prosthesis includes end plates (12.1 and 12.2) that are attached to opposing ends of adjacent vertebrae (16.1 and 16.2), respectively, and a floating meniscus (14) locatable between the end plates on which the end plates (12) articulate. Each end plate defines an inner side defining a convex articulation surface and an outer side defining a projecting keel formation and a beaded outer surface. The meniscus is concavo-concave defining complementary concave articulation surfaces on which the end plates articulate.

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## **AN INTERVERTEBRAL PROSTHESIS**

### **FIELD OF THE INVENTION**

5    THIS INVENTION relates to an intervertebral prosthesis.

### **BACKGROUND OF THE INVENTION**

Spinal discs may be removed for a number of reasons. When removed, the  
10    opposed vertebrae can be fused or the spinal disc may be replaced by an  
intervertebral prosthesis. The intervertebral prosthesis should provide the  
necessary articulation between the opposed vertebrae.

## SUMMARY OF INVENTION

According to the invention there is provided an intervertebral prosthesis which is locatable between two adjacent vertebral bones, the intervertebral prosthesis may include

first and second end formations that can each be attached to a different one of the vertebral bones; and

a meniscus which is locatable between the end formations and on which the end formations can articulate, characterised in that at least one of the end formations defines a convex articulation surface and the meniscus defines a complementary concave articulation surface.

Each of the end formations may define a convex articulation surface and the meniscus may be concavo-concave defining complementary concave articulation surfaces on which the end formations can articulate.

The radius of curvature of each of the convex articulation surfaces of the end formations may be different to the radius of curvature of the complementary concave articulation surfaces of the meniscus to thereby reduce the area of contact between the articulation surfaces, in use.

The convex articulation surfaces of the end formations may have a greater radius of curvature than the complementary concave articulation surfaces of the meniscus.

The apex of the convex articulating surface of each end formation may be disposed relatively closer to an operative posterior side of the end formation.

Each end formation may be in the form of an end plate having an inner side defining the convex articulation surface and an outer side defining a projecting keel formation for fixing the end plate to a vertebra.

The outer sides of the end plates from which the keel formations project may be generally convex to conform to the natural concave curvature of the vertebrae.

The outer sides of the end plates may define a beaded outer surface.

The convex and concave articulation surfaces may be of cast cobalt chrome.

## BRIEF DESCRIPTION OF THE DRAWINGS

Further features of the invention are described hereinafter by way of a non-  
5 limiting example of the invention, with reference to and as illustrated in the  
accompanying diagrammatic drawings. In the drawings:

Figure 1 shows a schematic top plan view of an end plate of an intervertebral  
prosthesis in accordance with the invention;

10

Figure 2 shows a sectional side view of the end plate of Figure 1, sectioned  
along line II - II of Figure 1;

Figure 3 shows a sectional posterior end view the end plate of Figure 1,  
15 sectioned along line III - III of Figure 1;

Figure 4 shows a schematic bottom plan view of the end plate of Figure 1;

Figure 5 shows a schematic top plan view of a meniscus of an intervertebral  
20 prosthesis in accordance with the invention;

Figure 6 shows a sectional end view the meniscus of Figure 5, sectioned along  
line VI - VI of Figure 5;

Figure 7 shows a schematic anterior view of an intervertebral prosthesis located between vertebrae in accordance with the invention; and

Figure 8 shows a schematic side view of the intervertebral prosthesis of  
5 Figure 8 located between the vertebrae.

With reference to the drawings, an intervertebral prosthesis in accordance with the invention is designated generally by reference numeral 10.

10 The intervertebral prosthesis 10 includes end formations in the form of end plates 12.1 and 12.2 that can be attached to opposing ends of adjacent vertebrae 16.1 and 16.2, respectively, and a meniscus 14 locatable between the end plates 12.1 and 12.2 on which the end plates 12 can articulate. The intervertebral prosthesis 10 is located, in use, between the vertebral bones  
15 16.1 and 16.2 to replace a damaged natural intervertebral disc.

The end plate 12.1 is attached to the superior vertebra 16.1 and the end plate 12.2 is attached to the inferior vertebra 16.2. The end plates 12.1 and 12.2 are identical in shape and configuration.

20

The end plates are of cast cobalt chrome. Each end plate 12 defines an inner side 21 and an outer side 22. The inner side 21 defines a convex articulation surface 18. The outer side 22 defines a convex outer surface 38 and a

projecting keel formation 20. The outer surface 38 is beaded and as such, defines a number of spaced "as cast" beads 40 which are formed in the casting process of the end plate.

- 5 Each end plate 12 is fixed to a vertebra 16 by cutting a notch in the vertebra and locating the keel formation 20 of the end plate 12 therein. The end plates 12 define an operative anterior side 32 and an operative posterior side 34. The end plates 12 are kidney-shaped in plan view and define an indentation 30 at the posterior side 34 to accommodate the spinal cord, in  
10 use. The apex 24 of the convex articulation surface 18 defines a loading point. The apex 24 of the convex articulation surface 18 and thus the loading point, is disposed relatively closer to the posterior side 34 of the end plate 12, thereby positioning the loading point closer to the posterior side.
- 15 The keel formation 20 projects from the outer surface 38 of each end plate 12 and is configured so that an end 36 of the keel formation is disposed opposite the apex 24 of the convex articulation surface 18. The surface 38 of the outer side 22, is convex to fit the natural concave curvature of the vertebra 16. The surface 38 is coated with a titanium and hydroxyapatite  
20 (HA) coating to improve bone growth. The beading 40 on the surface 38 enhances fixation of the end plate 12 to the vertebra 16 by improving bone growth onto the end plate.

The meniscus 14 is of cast cobalt chrome, is disc-shaped and is concavo-concave to define two concave articulation surfaces 26 and 28 which are identical in shape and configuration. In use, the meniscus 14 is located between the two endplates 12.1 and 12.2 so that the concave articulation surfaces 26 and 28 are in contact with the convex articulation surfaces 18 of the two end plates 12.1 and 12.2, respectively. The radius of curvature of the concave articulation surfaces 26 and 28 is different to the radius of curvature of the convex articulation surfaces 18 of the meniscus 14 thereby to reduce the amount of metal-on-metal contact between the articulation surfaces, in use. As such, body fluids are allowed to enter the gaps between adjacent articulation surfaces. This feature makes the articulation surfaces less prone to cold welding. In particular, the convex articulation surfaces 18 of the end plates 12 have a greater radius of curvature than the complementary concave articulation surfaces of the meniscus.

15

In use, in order to implant the intervertebral prosthesis a damaged natural intervertebral disc is surgically removed from its location between two adjacent vertebrae. Notches are then chiselled into the lower end of the superior vertebra 16.1 and the upper end of the inferior vertebra 16.2 from the anterior sides 32 of the vertebrae. The end plates 12.1 and 12.2 are fixed to the vertebrae 16.1 and 16.2, respectively, by locating the keel formations 20 of each end plate 12 in the chiselled notches. The ends 36 of the keel formations 20 serve as indicators to assist a surgeon to gauge the position of the apices 24



(and therefore the loading points) of the convex articulation surfaces 18. The position and depth of the ends 36 of the keel formations 20 in the vertebrae can be gauged by observing X-rays of the area. The meniscus 14 is positioned between the end plates 12 so that the convex articulation surfaces 18 of end  
5 plates 12.1 and 12.2 respectively, articulate on the concave articulation surfaces 26 and 28. The meniscus 14 is thus a separate component of the intervertebral prosthesis 10 that is located in a floating arrangement between the end plates 12 of the intervertebral prosthesis 10.

CLAIMS

1. An intervertebral prosthesis which is locatable between two adjacent vertebral bones, includes  
  
first and second end formations that can each be attached to a different one of the vertebral bones; and  
  
a meniscus which is locatable between the end formations and on which the end formations can articulate, characterised in that at least one of the end formations defines a convex articulation surface and the meniscus defines a complementary concave articulation surface.
2. An intervertebral prosthesis as claimed in Claim 1, characterised in that each end formation defines a convex articulation surface and the meniscus is concavo-concave defining complementary concave articulation surfaces on which the end formations can articulate.
3. An intervertebral prosthesis as claimed in Claim 2, characterised in that the radius of curvature of each of the convex articulation surfaces of the end formations is different to the radius of curvature of the complementary concave articulation surfaces of the meniscus to thereby reduce the area of contact between the articulation surfaces, in use.

4. An intervertebral prosthesis as claimed in Claim 3, characterised in that the convex articulation surfaces of the end formations have a greater radius of curvature than the complementary concave articulation surfaces of the meniscus.
5. An intervertebral prosthesis as claimed in any one of the preceding claims, characterised in that the apex of the convex articulating surface of each end formation is disposed relatively closer to an operative posterior side of the end formation.
6. An intervertebral prosthesis as claimed in any one of Claims 2 to 5, characterised in that each end formation is in the form of an end plate having an inner side defining the convex articulation surface and an outer side defining a projecting keel formation for fixing the end plate to a vertebra.
7. An intervertebral prosthesis as claimed in Claim 6, characterised in that the outer sides of the end plates from which the keel formations project are generally convex to conform to the natural concave curvature of the vertebrae.
8. An intervertebral prosthesis as claimed in Claim 6 or Claim 7, characterised in that the outer sides of the end plates define a beaded outer surface.

9. An intervertebral prosthesis as claimed in any one of the preceding claims, characterised in that the convex and concave articulation surfaces are of cast cobalt chrome.
10. A new intervertebral prosthesis substantially as described in the specification.
11. An intervertebral prosthesis substantially as described in the specification, with reference to and as illustrated in the accompanying diagrammatic drawings.

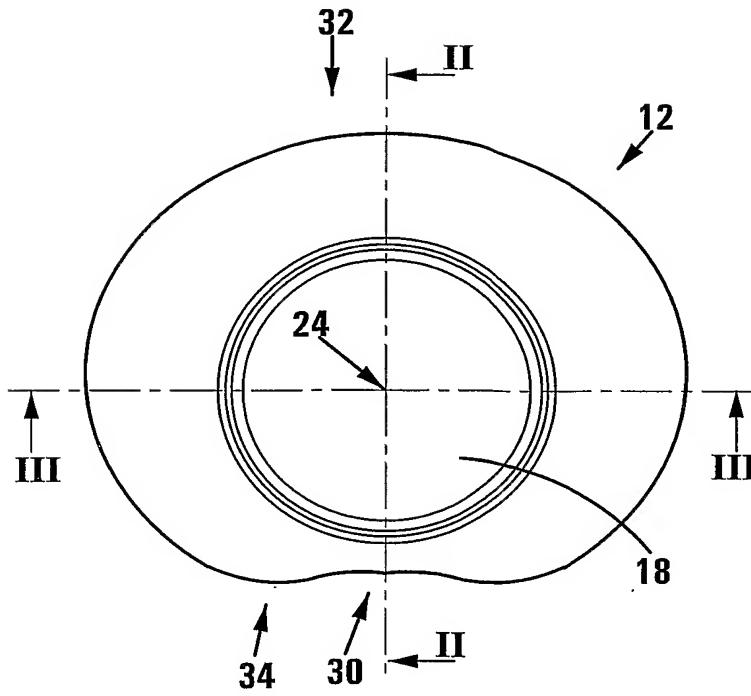


FIG 1

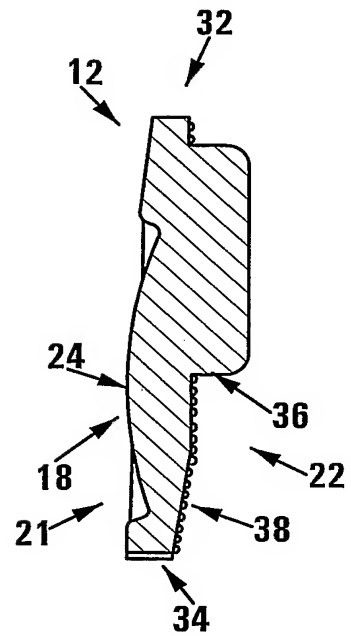


FIG 2

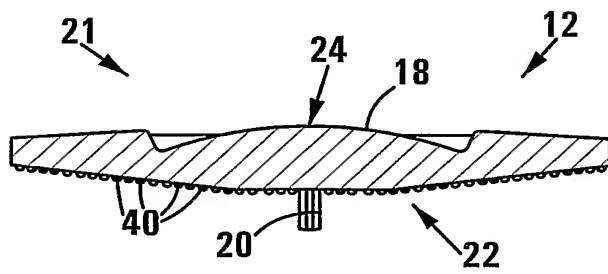


FIG 3

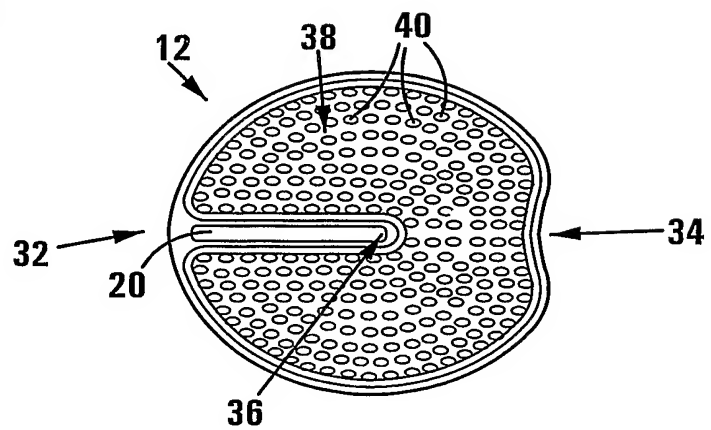
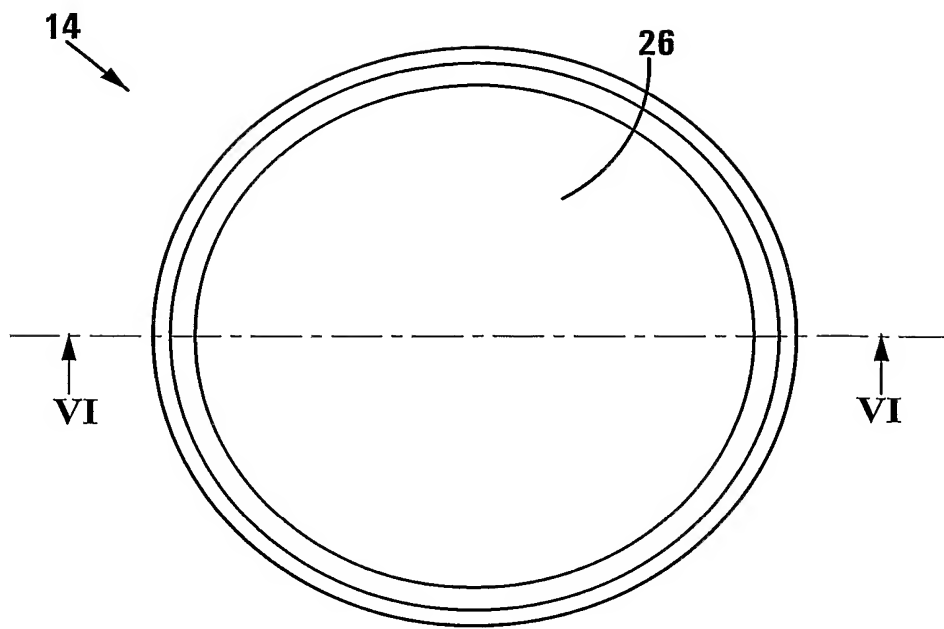
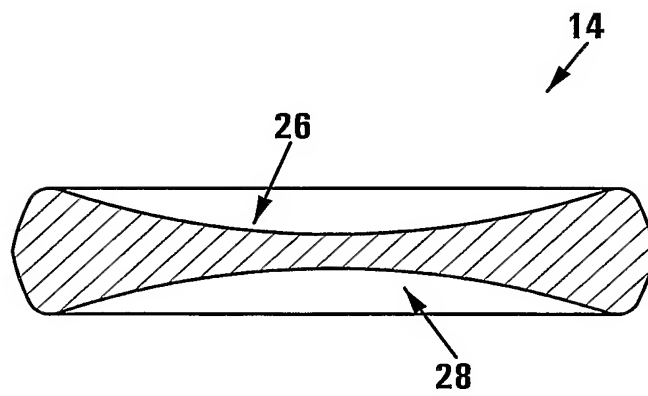


FIG 4

2/3



**FIG 5**



**FIG 6**

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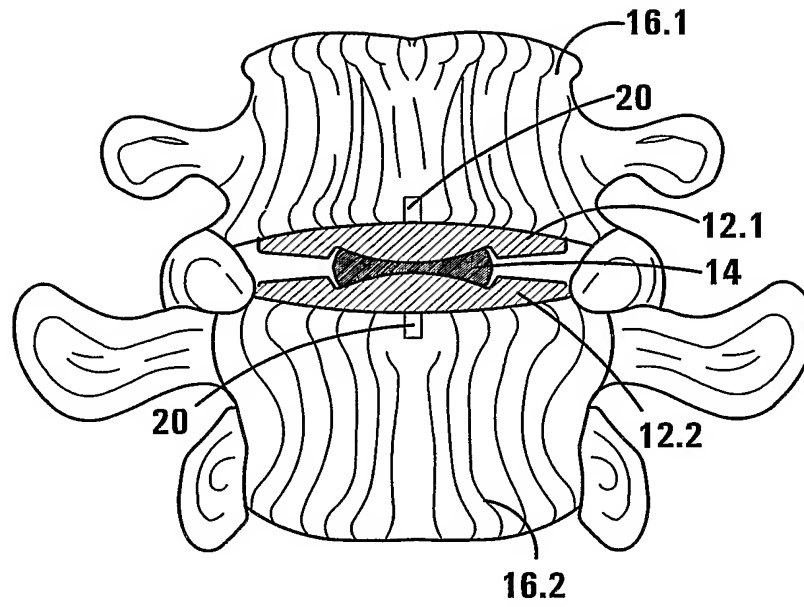


FIG 7

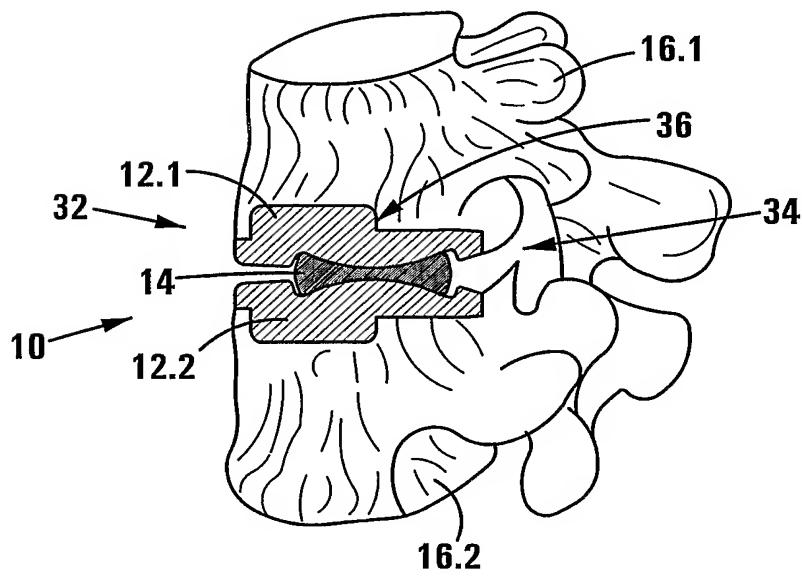


FIG 8

## INTERNATIONAL SEARCH REPORT

International Application No

.../IB2004/002827

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC 7 A61F2/44

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DD 239 523 A (UNIV BERLIN HUMBOLDT) 1 October 1986 (1986-10-01) figure 1 page 2, paragraph 5	1,2
Y		3,8,9
X	US 5 899 941 A (TANAKA KOICHI ET AL) 4 May 1999 (1999-05-04) figures 9A,9B,19A,10B	1
Y		3,8,9
X	US 6 368 350 B1 (GRIFFITH STEVEN L ET AL) 9 April 2002 (2002-04-09) figures 8-10	1,5
Y		3,8,9
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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*&\* document member of the same patent family

Date of the actual completion of the international search

13 January 2005

Date of mailing of the international search report

24/01/2005

Name and mailing address of the ISA

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Josten, S



## INTERNATIONAL SEARCH REPORT

ional Application No

IB2004/002827

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 676 701 A (SMALL LAURA C ET AL) 14 October 1997 (1997-10-14) column 5, line 51 - line 53 column 6, lines 9,10 -----	8,9
A	US 2003/045940 A1 (CASUTT SIMON ET AL) 6 March 2003 (2003-03-06) figure 6 -----	6
A	EP 1 188 423 A (SDGI HOLDINGS INC) 20 March 2002 (2002-03-20) figures 6,7,13,14 paragraph '0045! -----	5,7,8

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IB2004/002827**Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 10, 11  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 10,11

Claims 10 and 11 are unclear since they rely on references as " as described in the specification" or "with reference to and as illustrated in the accompanying diagrammatic drawings" (see Rule 6.2(a) PCT).

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

IB2004/002827

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